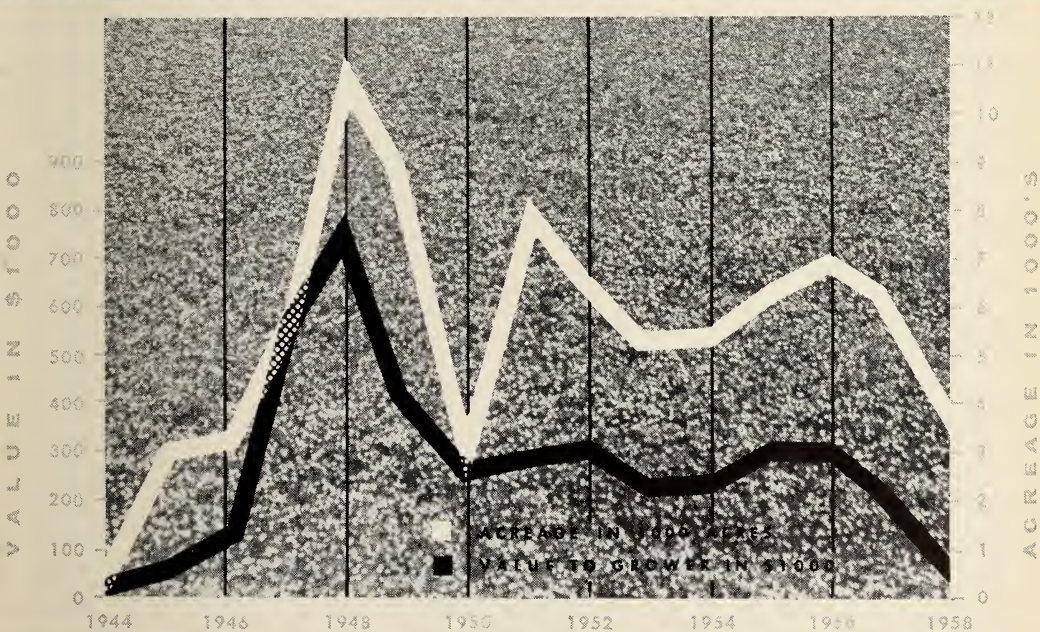




Division of Agricultural Sciences
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FLAX PRODUCTION IN SAN MATEO COUNTY

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Variety tests of flax, grown on land of cooperating farmers, have been used as a guide in the selection of better varieties for commercial production.

Commercial flax production in San Mateo County has been profitable since the end of World War II. Its success has been based on favorable growing conditions, improved cultural practices and disease control, and an increasing need for products using linseed oil and meal by the expanding population of California.

This circular brings together up-to-date information, based on research, which will be helpful in raising flax successfully in the coastal regions of San Mateo County and neighboring areas with similar climatic conditions.

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Flax production in the coastal area of California has been centered in the part of San Mateo County facing the Pacific Ocean. Its northern limit is Montara, and the southern limit Santa Cruz County. Plantings extend inland through all the principal valleys including Pescadero, San Gregorio, Tunitas, and Purisima. The entire area is subject to fogs during the summer when the flax is grown. In regions away from the ocean where summer fogs do not occur—i.e., the part of the county facing San Francisco Bay—

plantings have not been successful. Flax has occasionally been grown in similar areas of Santa Cruz and Monterey counties.

Most of the land used for flax is steeply rolling. Some level bottom lands are used for flax, but usually this land is reserved for vegetable crops such as artichokes or Brussels sprouts. Competing crops are barley, wheat, pastures, and both hairy vetch and oats for seed and hay. Some land in the county is still being reclaimed from brush, and flax is often the first crop sown.

How flax grows

Seeds of flax germinate very quickly in the presence of moisture. Under normal field conditions the seedlings appear above the ground in a week, though they may be delayed a few days longer by cool weather and deep planting. The seedlings are not vigorous nor strongly competitive with weeds.

Blossoms appear about two months after planting; plantings in the early spring take longer. Plants increase little in height after blossoming commences, and are 24 to 30 inches high at maturity. Under most conditions, when grown dry-

land, one central stem is produced, but if abundant moisture and nutrients are available strong branches will arise from the base of the plant. Smaller branches are abundant in the upper part of the plant, and these branches bear the flowers.

Flax varieties grown in San Mateo County have blue or light blue flowers. In other varieties color may vary from white, through various shades of blue and pink, to dark lavender. Flowers may also vary in shape and size. Flowering will continue for about three weeks if

the plant has sufficient nutrients and moisture, with a maximum amount of bloom about a week after flowering starts. Flowers in San Mateo County will open about 9 or 10 o'clock in the morning, and the petals will fall in the early afternoon. Each day brings a fresh lot of flowers.

The bolls of flax may be closed tightly (indehiscent) or partly open (semi-dehiscent). Varieties such as Argentine with closed bolls are difficult to thresh without rolls on the combine. Rolls are advisable also for partly-open varieties, since they facilitate threshing and reduce injury to the seeds. Each boll can produce up to 10 seeds, but normally the number varies from 6 to 10. An exceptional boll may produce more than 10 seeds, but it has not been possible to develop a variety that will do this consistently.

What it takes to grow flax in the way of...

Climate

The climate of coastal areas of San Mateo County is favorable to the production of flax. The summer fogs keep temperatures low, with temperatures averaging about 70° F., and maximum temperatures rarely rising above 80° F. They also keep the relative humidity high, thus permitting flax usually to complete its development without suffering from drought.

However, the high humidity has disadvantages, too. It favors the increase and spread of diseases such as rust, pasmo and Botrytis blight; and it leads to difficulties at harvest time—combines often can only operate in the drier afternoon and early evening, and the flax seed may have a moisture content too high for safe storage and may have to be dried artificially after harvest.

Seeds of flax may vary in color from yellow to dark brown, and in size from those that weigh 3 grams per 1,000 seed to those that weigh 12 grams. The seeds of San Mateo County varieties are brown in color, and the comparative weights of 1,000 seeds of the commercial varieties would be: for Argentine 8.0 grams, for Redwood 6.4 grams, and for B5128 also 6.4 grams. Flax seed is covered with a mucilaginous material that gives it a high gloss. It also causes the seeds to stick together if they are wet.

The culture of flax in San Mateo County varies considerably from farm to farm, with equally good results in terms of yields. The nature of the weather—mostly the duration and amount of winter rainfall—determines the schedule of farm operations.

Rainfall is ample in the coastal areas, varying from 18 inches along the coast to 45 inches at the higher elevations around 2,000 feet. All or most of the rain falls during the winter and before the flax is planted in the spring. It is sufficient to moisten the soil to field capacity beyond the depth of normal flax root distribution. Actually, most farmers would prefer no more rain after planting, since the rain will usually cause compaction or crusting of the soil and will encourage weeds. In some fields, spring runoff may lead to soil erosion; such erosion can occur after the flax is planted.

Flax is never irrigated in San Mateo County. Frost is rare, and never has been known to damage spring-seeded flax during the growing season.

Soil

Most soils of San Mateo County are suitable for growing flax. Highest yields are obtained on the deeper soils with a high water-holding capacity. Heavy soils that have been compacted do not give as high yields as medium-textured soils. Most soils in coastal areas are somewhat acid, with the pH sometimes going down to 5.0.

Rotation

Not many farmers in San Mateo County have a fixed rotation of crops; most of them choose their crops to some extent according to commodity-price outlook. Though some farmers have grown flax successfully for several years on the same field, this is not a recommended practice, and leads to depletion of organic matter in the soil, build-up in flax diseases, and possible damage from soil erosion.

Oats and hairy vetch are often grown alternately with flax; they are usually grown for seed, sometimes for hay. Wheat or barley may also be grown. A good rotation would be: one year oats; one year oats and vetch; and one or two years flax. More and more of the land in San Mateo County is being planted to dryland permanent pasture. This trend

has developed in response to increased livestock production and in order to prevent soil erosion. Ultimately, flax may be grown as a rotation crop on this pasture land.

Varieties

Argentine, though somewhat late, has been consistently good. It is not resistant to Fusarium wilt, but is resistant to rust. It is tall, and has large flat, light blue flowers. The bolls are closed tightly (indehiscent); the seeds brown and fairly large.

Redwood is perhaps the most widely grown variety because it yields well, and is resistant to rust and most races of Fusarium wilt. Redwood is about the same height as Argentine, but has smaller and darker blue flowers. The bolls are partly open (semi-dehiscent), and the seeds slightly smaller than those of Argentine.

B5128 is a parent of Redwood and similar to the latter in appearance, performance and disease resistance. It is a few days later than Redwood, and therefore has not been as popular for late plantings.

Flax varieties have been under test in San Mateo County for over 10 years. Some of the data from these tests are

Soil erosion sometimes occurs in fields of flax. Increased use of winter crops and permanent pasture in the rotation helps to control erosion and increase flax yields.



How the Three Major Varieties Compared in Yield Tests

Location	Year	Yield			Oil content			Iodine value		
		Argentine	Redwood	B5128	Argentine	Redwood	B5128	Argentine	Redwood	B5128
		bu./A.	bu./A.	bu./A.	per cent	per cent	per cent			
Pescadero	1949	34.4	27.9	31.0	....	....	....	....	....	....
Pescadero	1951	30.6	30.4	36.4	....	....	....	....	....	....
Pescadero	1952	23.1	19.2*	22.3	42.7	41.4	42.0	200	206	201
Pescadero	1953	29.4	26.4	24.0	37.1†	37.8†	36.6†	202	206	201
Halfmoon Bay	1953	14.4	11.4	10.6	37.4	36.3	35.4	203	204	201
Pescadero	1954	18.5	16.4	16.3	44.5	42.1	42.8	199	204	200
Halfmoon Bay	1954	22.8	22.4	19.9	44.6	44.4	42.7	206	208	200
Pescadero	1955	33.0	28.4	28.6	41.2	40.4	40.4	197	202	198
Pescadero	1956	41.8	37.5	40.7	42.3	41.1	41.9	191	196	190
San Gregorio	1956	24.8	25.0	25.3	42.9	42.3	42.7	197	205	192
Halfmoon Bay	1957	11.1	14.6	10.1	44.0	42.6	43.7	190	193	186
La Honda	1957	13.3	12.5	11.0	....	....	....	....	....	....

* Bird damage.
† Harvested early.

How Minor Varieties Compared in Yield Tests

Variety	C.I. No.	Year or years tested	Yield		Oil content	Oil iodine value	Wilt		Reaction to rust†
			Bu./acre	Per cent of Argentina			Burns field	Goat ranch	
					per cent		per cent		
Punjab	20	2 yrs. *	26.2	73.2	....	...	100	100	S
Punjab 47	1115	4 yrs. †	20.2	86.2	41.0	193	100	100	S
Imperial	1114	2 yrs. *	23.8	65.8	....	...	100	100	S
Punjab 53 . . . . .	....	2 yrs.	26.2	100.0	40.8	205	0	78	S
Signal	1157	3 yrs.	28.9	104.7	40.4	208	53	11	O

De Anza.....	1156	2 yrs.	26.8	100.6	43.6	199	100	100	O
Dakota.....	1071	2 yrs.	21.2	94.8	....	...	...	...	S
Dakota 52.....	....	2 yrs.††	16.4	63.8	38.2	206	4	1	S
Marine.....	1135	3 yrs.†	20.6	72.7	39.0	203	66	2	O
De Oro Selection.....	977-1	2 yrs.	25.0	96.6	38.6	207	22	4	O
Viking Selection.....	981-2	6 yrs.‡§	24.9	92.7	43.9	203	50	6	O
Arny.....	1658	2 yrs.	25.0	92.4	41.2	195	76	8	...
Biwing.....	917	1948	32.7	73.0	....	...	85	...	...
Turkey.....	862-417	1951	31.0	101.3	....	...	100	...	...
Minn. Selection.....	1155	1952†	20.3	87.9	39.0	203	62	15	O
Short Argentine.....	....	1953||	28.4	96.6	36.5	203	44	100	O
Linota Selection.....	....	1953||	23.3	79.2	36.0	204	6	1	O
Linda.....	1165	1956	41.7	99.7	41.1	190	44	21	...
Raja.....	1483	1956	38.4	91.8	40.3	191	67	57	...
Norland.....	....	1956	37.3	89.2	42.8	193	...	38	...

* Some damage by Botrytis blight.
† Damage by rust.
‡ Damage by birds.

§ Thin stand in some tests.
|| Harvested when green.
¶ S—susceptible; O—no rust; other varieties not tested.

given in the tables on these two pages. Varieties produced in other parts of the nation will be tested as they become available, in the hope to develop a variety particularly well adapted to the county.

Until 1952 **Punjab** was the principal variety grown, with Argentine of secondary importance. Much of the planting seed of Punjab was brought into the county from Imperial Valley and the San Joaquin Valley where Punjab was the main variety. Punjab 47 and Imperial, both selections of Punjab, were released in Imperial Valley about 1947. Though not grown commercially in San Mateo County, in test plots they have been found to be similar to Punjab in yield and behavior. Punjab 53 is a wilt-resistant variety developed from a single plant of Punjab surviving on wilt-infested soil in San Mateo County in 1948. It is also similar to Punjab under San Mateo County conditions. Unfortunately Punjab and all the varieties developed from it are susceptible to rust, and are not recommended for coastal areas. The same is true of New River, a wilt-resistant variety recently developed for Imperial Valley.

Dakota, at one time a widely-grown variety of the Northern Great Plains, was found to be a good variety for late plantings because of its early maturity. However, it proved to be susceptible to rust.

Time of planting

Plantings are made from November to May 15. Though the best planting time varies from year to year, the most successful date has been about April 1. Pasmó has usually caused extensive damage in fall plantings, and frequently has reduced the yields of flax sown in February and early March. Yields are generally reduced by planting after April 1, but delays may be necessary if the soil is slow in drying out after winter rains.

Local and Imported Seed Gave Similar Yields in Limited Tests, 1956

Variety	Source of seed	Halfmoon Bay test			La Honda test		
		Yield	Oil content	Iodine value	Yield	Oil content	Iodine value
		bu./A.	per cent		bu./A.	per cent	
Redwood	Local.....	32.2	39.4	202	20.5	40.6	202
	North Dakota.....	33.6	41.6	200	19.4	41.1	202
B5128	Local.....	34.2	41.8	196	19.7	40.9	197
	North Dakota.....	36.5	40.7	192	19.8	40.6	196

Seedbed preparation

The land is plowed in January or February; disked in February or March; and reworked with a spring-toothed harrow just prior to seeding to kill weeds that have germinated. A spike-toothed harrow is used also to level the seedbed. The timing of these operations depends on the pattern of the winter rains and the date selected for planting. It is important that the seedbed be well worked down, firm, and free from weeds or volunteer grain. Moist soil should be close to the surface.

Seed

Most locally-grown seed has a high moisture content and therefore is not suitable for planting. Much of the planting seed is imported from the Northern Great Plains, principally from North and South Dakota. Only certified seed has been, and should be, imported. Locally-grown seed, with a moisture content below 10 per cent, has been used successfully for planting (see table above). Such seed has come from the southern end of the county

where there is more sunshine at harvest time. Select locally grown seed carefully, and give it a germination test before planting. The cost of planting seed has varied between 10 and 13 cents per pound during recent years.

Seed treatment

Treat all seed with an organic mercuric fungicide such as New Improved Ceresan or a similar product at the rate recommended by the manufacturer. Seed treatment kills the spores of disease carried on the surface of the seed and, for the first few days after germination, protects the seed from diseases generally present in the soil.

Planting

Where planting conditions are ideal, $\frac{3}{4}$ of a bushel, or 42 pounds, of seed per acre should be sufficient. Where some of the seed will not germinate because it drops in dry soil, or where rain may crust the soil, increase the seeding rate to 50 pounds per acre.

Highest Yield Resulted from 6-inch Spacing (Pescadero, 1957)

Row spacing	Yield	Oil content	Iodine value of oil	Amount of corn spurry
inches	bu./A.	per cent		
6.....	14.3	43.5	192	Moderate
12.....	11.8	43.8	189	Abundant
18.....	10.7	43.5	190	Abundant

Use a regular single- or double-disk grain drill with 6-inch row spacings. Wider row spacings have given lower yields (see the table on page 8 bottom). Set the drill to plant the seed into moist soil, but no deeper than necessary. A depth of 1 inch is preferred, and no more than 2 inches. It is customary to ring roll (cultipak) after seeding, if no rain is expected within a few hours after seeding. This leaves the ground in smooth condition for harvest and firms the soil around the seed, improving chances for even germination.

Cultivation after planting

Heavy rains immediately after seeding will often cause the soil to crust. Seedlings have difficulty getting through the crust, and a thin stand frequently results. Growers have found that a light harrowing as soon as possible after a rain will break the crust and improve the stand. If the seedlings are partly emerged when the soil dries, the harrowing may do more harm than good. In this case, if the stand is very thin, replant after a shallow cultivation.

Fertilization

Fertilizers of the nitrogen, phosphorus, potash and combination types are used on flax both on a field scale and in experimental plots. The flax often responds markedly to the fertilizer in early stages of its development, but the yields of fertilized and unfertilized areas have shown little difference. To date the use of commercial fertilizer on flax in this area has not been profitable.

Flax, after a crop of oats and vetch which had been given a phosphorus fertilizer, has sometimes shown an increase in yield.

Weed control

Weeds are a problem in all flax-production areas. Herbicides greatly facilitate their control, but a rotation and

good cultural practices may keep down weed control expenditures. The principal weeds of flax in San Mateo County are annual radish (*Raphanus sativus*), mustard (*Brassica arvensis*), red pigweed (*Amaranthus hybridus*), corn spurry (*Spergula arvensis*), and wild oats (*Avena fatua*).

The most effective herbicide in the control of the broadleaf weeds is 2,4-D (2,4-dichlorophenoxyacetic acid) — a hormone type herbicide which, in susceptible plants, causes severe plant distortion or death within one to three weeks. It should be applied to flax in the following manner:

1. Use the amine salt of 2,4-D. It is sold as a liquid and goes readily into solution in water. The sodium and ammonium salts are as effective as the amine, but are more difficult to handle because they are solids. Ester formulations of 2,4-D are too toxic to flax.

2. Use 3 to 4 ounces of acid equivalent per acre. This will be $\frac{3}{8}$ to $\frac{1}{2}$ pint if the formulation contains 4 pounds per gallon. Applications with a ground rig may be made in as little as 15 gallons of water per acre, and by airplane down to 5 gallons of water per acre. Pressures in the nozzles of ground rigs should be 25–30 pounds per square inch. The cost of the material varies from 24 to 32 cents per acre, and the cost of application from \$1.00 to \$2.00 per acre.

3. Apply when the flax is 2 to 4 inches high, and no higher than 8 inches. After treatment the flax may have twisted stems, fused leaves at the plant tip, and deformed bolls. Late applications will show more distortion, and very late applications will destroy buds and blossoms with a serious reduction in yield. *The timing of the application is extremely important.* The best kill of weeds will be obtained when the weeds are not more than 5 inches high and growing vigorously.



Spots of Fusarium wilt in flax. Weeds often occupy the area killed by wilt.

MCP (2-methyl-4-chlorophenoxyacetic acid) is similar to 2,4-D in its effect on most plants, but costs about twice as much. Limited data from other areas would indicate that it is less toxic to flax than 2,4-D, and about as effective in controlling weeds. Rates, timing, and other

Wilt nursery south of Pescadero. The bags on the plants protect selected plants from bird damage. The flax on the horizon (Redwood) is free from rust, and that in the foreground around the test area (Dakota) is badly infested with the disease.



procedures for using MCP are the same as for 2,4-D.

IPC (Isopropyl-N-phenyl carbamate) has been successfully used in Imperial Valley to control wild oats. Its use in San Mateo County for the control of this weed or other grasses is not recommended because it must be washed into the soil by rain or irrigation water to be effective, and the cost will approximate \$10 per acre. Very little moisture in the form of rain usually falls on the flax after seeding, and the crop is dry farmed.

Disease control

Several diseases affect flax in San Mateo County, and every effort should be made to control them through seed treatment, resistant varieties, and good cultural practices. The more important diseases are Fusarium wilt, Rhizoctonia wilt, Botrytis blight, rust, and pasmo.

Fusarium wilt (*Fusarium oxysporum* f. *lini*) is a disease that is widespread throughout the flax-growing areas of the United States. In San Mateo County it was first found in 1948, in an area that had been planted to flax some 50 years before. Wild flax growing in the area presumably had been the host plant.

This disease usually appears first as small patches of dead flax. Patches one or two feet in diameter indicate that the disease had been present for about two years. With every crop of flax the patches will increase in size, and usually become irregular in shape because of movement of the fungus by cultivation or runoff water. Plants may be killed at any stage.

Keeping flax off fields having this disease will not reduce its severity appreciably, since it is able to persist in the soil indefinitely.

Where Fusarium wilt is present, use the resistant varieties Redwood and B5128. Seed treatment will kill spores of this disease carried on the seed, but will not kill the disease inside of small bits of stem that may be present in the seed.



Left: Fusarium wilt tests in the greenhouse at Davis indicate the varieties most resistant to this disease. Right: Characteristic of the wilt are curled tips.

Rhizoctonia (*Rhizoctonia solani*), like the Fusarium wilt organism, is soil-borne and attacks the plants at the crown (not through the roots). It is most severe in early stages of the plant growth. The fungus is favored by relatively warm, moist soil. In some cases stands have been reduced as much as 25 per cent.

Where damage from this disease is expected, delay plantings until most of the winter rains are past. Seed treatments will give some degree of control. No varieties are known to have resistance to this disease.

Botrytis blight or gray mold (*Botrytis cinerea*) is the most widespread disease in San Mateo County. Spores are present everywhere, and it attacks many other crops as well. It is favored by high humidity, and usually gains access to the plant through a dead, adhering petal. Because of this means of entrance, it usually attacks individual bolls, causing them to be empty or to contain shriveled seed at harvest. On close examination a cottony brownish fungus may be seen on the surface of the boll. When the variety Punjab was widely grown, damage was as high as 50 per cent in some locations, the damage being more severe because Punjab tended to hold its petals. The

varieties Redwood, B5128 and Argentine are not seriously affected.

Rust (*Melampsora lini*) appeared in San Mateo County for the first time in 1952. Presumably it came in on seed from the Northern Great Plains. Susceptible varieties in the following year, fortunately being grown on a small proportion of the total acreage, suffered considerable damage. With the use of the resistant varieties Redwood, B5128, and Argentine the disease persisted only on volunteer plants of susceptible varieties, and has not been seen since 1955.

Symptoms of pasmo disease—dark brown areas on the stem.





Botrytis blight has attacked the two bolls on the right. Such bolls produce little or no seed.

The spores of this disease may be carried on seed, or may survive the winter on flax straw. As a consequence, seed should be treated before planting and a flax field infested with rust should be planted to some other crop for a year. Once rust becomes established in a flax field there is nothing that can be done to control it. The spores are spread rapidly and widely by wind.

Pasmo (*Sphaerella linorum*) has been frequently observed on flax in San Mateo County, but has rarely caused severe damage. Damage in excess of 50 per cent

has been observed in flax sown in the fall and in February. In both cases the crop had been exposed to large amounts of rain which facilitates the spread of the disease. Affected plants frequently have a banded appearance, with green tissue alternating with brown and diseased parts. Plantings made after the first of April usually do not suffer from this disease. Do not plant seed from diseased fields, and sow diseased fields to some other crop for one year.

Browning or stem break (*Polyspora lini*) has never appeared in epidemic amounts, and is usually detected when infected plants break over at the soil line. Brown lesions appear on the lower portions of the stem and lower leaves, and spread upward. The entire plant may turn brown, and small patches in the field may be affected. It is usually introduced on seed, and seed treatment will destroy the spores on the surface of the seed. Spores inside the seed are unaffected by seed treatment; for this reason do not plant seed from affected fields.

Insects

Insect damage has never been severe on flax in San Mateo County, and control measures are not necessary. Slight damage has been caused by the variegated cutworm, the yellow striped armyworm, and the omnivorous leaf tier.

The harvesting and marketing of flax

All flax in the county is harvested directly by combine. Most of the machines have 5- to 12-foot cutter bars, and all are equipped with rubber rolls. Machines with self-leveling mechanisms are being used to great advantage in the steeply rolling fields. Bulk equipment is increasing, but a large part of the crop is sacked and delivered in this form to the processor.

Do not start harvesting until the bolls and straw are dry—usually in early September. The minimum level of moisture for safe storage is 11 per cent, and the farmer's selling price is based on this moisture content.

Actually in some areas of the county it is difficult to reduce the moisture to 11 per cent, and some of the flax is harvested with a moisture content as high as 16

per cent. The processing company receiving such flax must arrange either to process it immediately or dry it.

All of the flax seed has been delivered by truck to the processor in San Francisco.

Disposal of flax straw

Flax straw does not disintegrate readily in threshing, and usually persists after harvest as tangled clumps or windrows. Where the stand is heavy, these are difficult to incorporate into the soil

by tillage. The incorporated straw decomposes very slowly and interferes with the planting of subsequent crops. Many farmers have elected to burn the threshed windrows even though they realize that they are destroying organic matter in the process. Burning destroys many disease spores in and on the straw that would be carried over to infect the following flax crop. Until better methods for disposal are developed, burning appears to be the only economical way to handle the straw.

USDA Grades for Flaxseed

Grade No.	Minimum test weight per bushel	Maximum limits of damaged flaxseed*
	pounds	per cent
1.....	49	20
2.....	47	30
Sample grade.....	Sample grade shall include flaxseed which does not come within the requirements of either of the grades No. 1 or No. 2; or which contains fire-damaged flaxseed; or which contains more than 11 per cent of moisture; or which is musty, sour, heating, or hot; or which has any commercially objectionable foreign odor; or which is otherwise of distinctly low quality.	

* Damaged flaxseed shall be seeds and pieces of seeds of flaxseed which are heat damaged, sprouted, frosted, badly ground damaged, badly weather damaged, or otherwise materially damaged.

Flaxseed Prices in Dollars per 100 Pounds

Year	Price paid farmers			Support price		
	Average San Mateo	Average California	Average U. S.	Average California	San Mateo	U. S.
1948.....	11.16	11.04	10.20	10.82†	10.93†	10.27
1949.....	7.14	7.04	6.48	7.05†	7.16†	6.68
1950.....	6.70	6.89	5.96	4.96†	5.07†	4.59
1951.....	7.68	8.46	6.64	5.18†	5.29†	4.73
1952.....	7.14	7.57	6.64	7.04	7.30	6.73
1953.....	6.43	6.82	6.50	7.32	7.36	6.77
1954.....	5.98	5.93	5.45	6.20	6.21	5.61
1955.....	5.96	5.96	5.18	5.66	5.79	5.20
1956.....	6.07	6.52	5.34	6.03	6.14	5.52
1957.....	5.76*	5.71	5.39	5.77	5.88	5.21

* Estimated price of No. 1 flaxseed produced in San Mateo County delivered at Richmond, California.

† Estimated from terminal support rate at San Francisco and Los Angeles.

Note: 1 bushel = 56 pounds.

Marketing flaxseed

One company purchases most of the flaxseed grown in San Mateo County. This company guarantees the farmers a market for their flax, and in recent years has set the price before harvest on the basis of the price of flaxseed in the Minneapolis market and the prevailing prices for linseed oil. Flax price relationships for recent years are given in the table on page 13, bottom.

Grades. The three U. S. official grades which have been established for flax-

seed are given in the table on page 13, top. Most of the flax sold in San Mateo County has been on a grade basis.

The moisture content must be 11 per cent or less for the flax to qualify for Grades No. 1 and 2. The distinction between these numbered grades is based on bushel weight.

The grade is not affected by "dock-age"—foreign material such as broken stems and chaff that is harvested with the seed. Even so, set your combines to reduce dockage as much as possible, since it costs money to transport trash.

Products from the flax plant

Linseed oil

The oil from flax seed—linseed oil—is used for a variety of products. Most of it goes into the paint and varnish industry. The oil after appropriate treatments or additives dries quickly into a tough film. It is also used in products such as linoleum, oil cloth, molds for castings, and printers ink. The oil is not used in food, partly because it tends to develop undesirable flavors rather quickly after processing.

Flax seed, as grown elsewhere, may contain from 32 to 42 per cent oil. Well-developed flax seed in San Mateo County yields from 39 to 41 per cent oil. The usual method of processing does not remove all the oil; a small amount remains in the meal.

Iodine value or iodine number is an index of the drying quality of the oil. The greater the number the better the drying properties. Linseed oil from San Mateo County is unusually high in iodine value, reaching above 200 in many instances (see tables on pages 6 and 7). Currently there is no premium paid by the paint and varnish industry for high iodine-number linseed oil, though this industry does have certain minimum standards for iodine value that must be met.

Linseed meal

The crude protein content of the meal or cake varies from 30 to 38 per cent, and usually averages around 34 per cent. The amount of oil in the meal depends upon the method of processing. The meal is popular with livestock feeders not only because of the high protein content (see table on page 15), but because of its good palatability and slight laxative effect.

Feed value of flax straw

Flax straw is rarely fed to livestock. If mature and of good quality, it is about equal to oat or barley straw in feed value. It can be used safely as the only roughage for cattle. The fibers are digested like other fibrous materials and do not accumulate in the stomach to form indigestible balls.

Green flax straw should be fed with caution, because immature flax may contain poisonous amounts of prussic acid. The danger is greater if the immature flax is frozen. Volunteer flax appearing after harvest may be unsafe as pasture because it may possibly contain this poisonous material.

Linseed Meal is High in Protein*
(Feed value comparisons with flax straw)

	Total dry matter	Average total composition					Digestible protein	Total digestible nutrients
		Protein	Fat	Fiber	N-free extract	Mineral matter		
	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Flax straw	92.8	7.2	3.2	42.5	32.9	7.0	5.8	38.1
Oat straw	89.8	4.1	2.2	36.3	40.9	6.3	0.7	44.8
Barley straw	90.0	3.7	1.6	37.7	41.0	6.0	0.7	42.2
Linseed meal								
(o.p.)†	91.0	35.1	4.5	9.0	36.7	5.7	30.5	75.3
Linseed meal								
(s.p.)†	90.1	36.6	1.0	9.3	38.3	5.8	30.7	70.3
Cottonseed meal†	92.8	43.3	5.1	11.0	27.4	6.0	35.9	72.6

* Data from Morrison, F. B., "Feeds and Feeding," Morrison Publishing Co., Ithaca, N.Y., 1956.

† o.p. = old process, using hydraulic press or expellers; s.p. = solvent process.

‡ 43% protein grade.

Seed flax straw a source of fiber

Large amounts of seed flax straw are processed each year in the United States to obtain fiber. The fiber content of straw is about 10 per cent, and the fiber is contained in the bark. The extracted fiber is manufactured into high-grade types of paper such as cigaret paper, Bible paper, carbon paper and air-mail bonds.

Not enough flax is grown at present in San Mateo County to justify the establishment in the area of a processing plant to remove the fiber. The high humidities may make it difficult to separate the fiber from the rest of the stem.

Fiber flax for San Mateo County

Linen, one of the finest of fabrics, is made from flax that has been developed for that purpose. Such flax has long fine stems that produce a high-quality fiber. For several reasons, however, a fiber-flax industry is not feasible in San Mateo County, all of them related to the time and cost to remove the fiber from the stems. Plants must be pulled by hand and with a special machine, and tied into sheaves. The sheaves are "retted"—soaked in a tank of water until the non-fibrous portions of the stem have rotted in part—then dried and stored for processing. The yield of the fiber would not be above 400 pounds per acre, with the price not much above 40 cents per pound.

Costs of production

The table on this page outlines the relative costs of the various operations connected with farming flax in San Mateo County in 1957. It was prepared as a sample from actual farming records. The normal miscellaneous charges including taxes, depreciation, interest in the invested capital, etc., have been apportioned among the various operations. These data are useful only as a general guide to flax-production costs in coastal districts and are not necessarily repre-

sentative of the average costs of growing the crop there. Moreover, a given operator usually does not find it necessary to perform all these operations every year. For example, he may not need to float his field before planting. After planting it may not be necessary to cultipack the field. Rent costs vary; in cases sampled here, some of the operators obviously had negotiated especially favorable leases.

Flax Production Costs in San Mateo County (Sample 1957. Assumptions: size of operation 300 acres and 900 lbs/acre yield)

Operation	Cost per acre
Plowing.....	\$ 4.00
Disking (once).....	2.50
Spring-tooth harrowing (once).....	2.50
Floating or landplaning.....	3.00
Planting.....	2.00
Seed.....	6.00
Cultipack.....	2.00
Herbicide application.....	2.00
2,4-D amine.....	.30
Harvest.....	7.00
Hauling (22¢ cwt—900 lb./A.).....	2.00
Burning straw.....	1.50
Rent.....	7.00
Total costs.....	\$41.80

Note: The above costs are computed to include overhead costs such as repairs, taxes on equipment, compensation and other insurance, depreciation and interest on investment including that in equipment. No charge has been made for sacks since bulk handling is assumed.

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